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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/866,665	05/30/2001	Takaharu Kondo	35.C15382	5130

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EXAMINER	
MUTSCHLER, BRIAN L	
ART UNIT	PAPER NUMBER
1753	

DATE MAILED: 02/09/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	**Application No.** 09/866,665	**Applicant(s)** KONDO ET AL.
	Examiner Brian L. Mutschler	**Art Unit** 1753

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 28 July 2003 and 29 August 2003 (RCE).

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-15 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-15 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☒ Interview Summary (PTO-413) Paper No(s). 15 .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on July 28, 2003, has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-7 and 10-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuda et al. (U.S. Pat. No. 5,571,749) in view of Yamazaki (U.S. Pat. No. 6,028,264) and in view of Yamazaki (U.S. Pat. No. 5,556,794), herein referred to as US '749, US '264 and US '794, respectively.

US '749 discloses a method for producing silicon thin films, particularly for use in solar cells, using high-frequency plasma CVD (col. 15, line 9). US '749 discloses forming i-type silicon thin films using a material gas comprising silicon fluoride, hydrogen and oxygen (col. 15, lines 36-53; col. 33, line 60; col. 34, line 12). The flow

rate of the hydrogen is usually much higher than the flow rate of the silicon containing gas (see Tables 1-5). The examples shown in US '749 are formed at pressures higher than 50 mTorr (Tables 1-5). US '749 further discloses the use of oxygen-containing gases in the material gas mixture (col. 15, line 34).

The method and thin film of US '749 differs from the instant invention because US '749 does not disclose following:

a. The concentration of oxygen contained in the material gas is 0.1 to 0.5 ppm based on a concentration of silicon atoms, as recited in claims 1, 4 and 10; and

b. The silicon thin film contains oxygen atoms at a concentration of from 1.5×10^{18} atoms/cm^3 to 5.0×10^{19} atoms/cm^3, as recited in clams 5 and 11.

US '794 and US '264 teach methods for reducing the oxygen concentration in the layers of silicon thin films using molecular sieves or zeolites to adsorb oxygen when forming i-type layers solar cells having pin junctions (US '264 col. 6, line 20). US '264 teaches the formation of an i-type silicon thin film layer having an oxygen concentration less than 5.0×10^{19} atoms/cm^3 and as low as 5.0×10^{18} atoms/cm^3 (col. 6, line 26). US '794 teaches the formation of an i-type silicon thin film less than 5.0×10^{18} atoms/cm^3 or as low as 5.0×10^{15} atoms/cm^3 (col. 8, line 62; col. 9, line 44).

Regarding claims 5 and 11, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the silicon thin film of US '749 to use a thin film having an oxygen concentration of 1.5×10^{18} atoms/cm^3 to 5.0×10^{19} atoms/cm^3 as taught by US '264 and US '794 because oxygen in the intrinsic

layer of solar cells act as donor centers and decreases the photo-sensitivity of solar cells (US '794 col. 3, lines 19-42).

Claims 5 and 11 are product-by-process claims, and as such, if the product is the same as or obvious from a product of the prior art, the claim is unpatentable (see MPEP § 2113). Since all of the references teach the use of a CVD method and US '794 and US '264 disclose the oxygen concentration in the final product, the instant claims would have been obvious over the prior art.

Furthermore, in light of the fact that US '794 and US '264 teach the formation of silicon layers having the specified oxygen concentration, and because the oxygen concentration that is deposited is dependent on the concentration contained within the material gas, it would have been inherent in the fabrication process of US '794 and US '264 to have used a material gas with an oxygen concentration of 0.1 to 0.5 ppm based on the concentration of silicon atoms. Using the specified process, a different oxygen concentration would have yielded a different concentration of oxygen in the deposited layer.

4. Claims 8 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuda et al. (U.S. Pat. No. 5,571,749) in view of Yamazaki (U.S. Pat. No. 6,028,264) and in view of Yamazaki (U.S. Pat. No. 5,556,794), as applied to claims 1-7 and 10-13, and further in view of JP 2000-77694. References to JP 2000-77694 are made using the column and line number references of Higashikawa (U.S. Pat. No. 6,252,158),

herein referred to as US '158, which is the U.S. patent in the JP 2000-77694 patent family.

US '749, US '264 and US '794 disclose a method and silicon thin film having the limitations recited in claims 1-7 and 10-13 of the instant invention, as explained above in section 3. The method and device described by US '749, US '264 and US '794 further differs from the instant invention because they do not disclose having a crystalline Raman scattering at least three times greater than the Raman scattering due to amorphous components.

Raman scattering shows the level of crystallization within silicon layers. The ratio of crystalline component to amorphous component gives a measurement for the crystal volume within the layer, i.e., a film having a crystalline component with a Raman scattering three times greater than the Raman scattering of the amorphous component has a crystal volume of 75%.

US '158 teaches a solar cell structure having several microcrystalline intrinsic layers with crystal volumes ranging from 30% to 99% (col. 11, line 66 to col. 12, line 3). Microcrystalline silicon solar cells avoid "the optical degradation phenomenon (Staebler-Wronski effect) specific to the amorphous semiconductors" (col. 2, lines 47-52).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the silicon thin film described by US '749, US '264 and US '794 to use a thin film having a crystalline Raman scattering three times greater than the amorphous Raman scattering, as taught by US '158, because a higher

crystalline Raman scattering helps avoid the deleterious effects of optical degradation associated with amorphous semiconductors (US '158 col. 2, lines 47-52).

5. Claims 9 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuda et al. (U.S. Pat. No. 5,571,749) in view of Yamazaki (U.S. Pat. No. 6,028,264) and in view of Yamazaki (U.S. Pat. No. 5,556,794), as applied to claims 1-7 and 10-13, and further in view of JP 11-310495. References to JP 11-310495are made using the column and line number references of Kondo (U.S. Pat. No. 6,103,138), herein referred to as US '138, which is the U.S. patent in the JP 11-310495 patent family.

US '749, US '264 and US '794 describe a method and silicon thin film having the limitations recited in claims 1-7 and 10-13 of the instant invention, as explained above in section 3. The silicon film described by US '749, US '264 and US '794 further differs from the instant invention because they do not disclose having a diffraction intensity of the (220)-plane comprising at least 50% of the total diffraction intensity.

US '138 teaches the use of thin films having diffraction intensities in the (220)-plane at least 30% of the total diffraction intensity because "the thin film will have notably improved carrier mobility" (col. 3, lines 37-40). US '138 further discloses specific examples of thin films having diffraction intensities in the (220)-plane from 50% to 60% relative to the total diffraction intensity (table 2).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the thin film of US '749, US '264 and US '794 to use a thin film having a diffraction intensity in the (220)-plane at least 50% of the total

diffraction intensity, as taught by US '138, because using such a thin film will have a "notably improved carrier mobility" (US '138 col. 3, lines 37-40).

Double Patenting

6. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970);and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

7. Claims 1-15 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-16 of copending Application No. 09/865,549 in view of Yamazaki (U.S. Pat. No. 6,028,264) and in view of Yamazaki (U.S. Pat. No. 5,556,794), herein referred to as App. '549, US '264 and US '794, respectively.

Claims 1, 2, 5, 6, 11 and 12 of App. '549 claim a method and silicon thin film formed using a silicon halide and hydrogen, wherein the silicon halide is a silicon fluoride. Claims 3, 7 and 13 recite the limitation that the flow rate of hydrogen is not less than the flow rate of the silicon halide. Claims 4, 8 and 14 recite the limitation that the pressure is 50 mTorr or more. Claims 9 and 15 recite the limitation that the Raman

scattering from a crystalline component is at least three times greater than the Raman scattering from an amorphous component. Claims 10 and 16 recite the limitation that the percentage of diffraction intensity for the (220)-plane is at least 50% of the total diffraction intensity.

App. '549 differs from the instant invention because App. '549 does not disclose having oxygen present in the material gas at a concentration or from 0.1 ppm to 0.5 ppm, as recited in claims 1, 4 and 10, and a oxygen concentration in the formed silicon film having a concentration of 1.5×10^{18} atoms/cm^3 to 5.0×10^{19} atoms/cm^3, as recited in claims 5 and 11.

US '794 and US '264 teach methods for reducing the oxygen concentration in the layers of silicon thin films using molecular sieves or zeolites to adsorb oxygen when forming i-type layers solar cells having pin junctions (US '264 col. 6, line 20). US '264 teaches the formation of an i-type silicon thin film layer having an oxygen concentration less than 5.0×10^{19} atoms/cm^3 and as low as 5.0×10^{18} atoms/cm^3 (col. 6, line 26). US '794 teaches the formation of an i-type silicon thin film less than 5.0×10^{18} atoms/cm^3 or as low as 5.0×10^{15} atoms/cm^3 (col. 8, line 62; col. 9, line 44).

Regarding claims 5 and 11, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the silicon thin film of App. '549 to use a thin film having an oxygen concentration of 1.5×10^{18} atoms/cm^3 to 5.0×10^{19} atoms/cm^3 as taught by US '264 and US '794 because oxygen in the intrinsic layer of solar cells act as donor centers and decreases the photo-sensitivity of solar cells (US '794 col. 3, lines 19-42).

Claims 5 and 11 are product-by-process claims, and as such, if the product is the same as or obvious from a product of the prior art, the claim is unpatentable (see MPEP § 2113). Since all of the references teach the use of a CVD method and US '794 and US '264 disclose the oxygen concentration in the final product, the instant claims would have been obvious over the prior art.

Furthermore, in light of the fact that US '794 and US '264 teach the formation of silicon layers having the specified oxygen concentration, and because the oxygen concentration that is deposited is dependent on the concentration contained within the material gas, it would have been inherent in the fabrication process of US '794 and US '264 to have used a material gas with an oxygen concentration of 0.1 to 0.5 ppm based on the concentration of silicon atoms. Using the specified process, a different oxygen concentration would have yielded a different concentration of oxygen in the deposited layer.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Response to Arguments

8. Applicant's arguments filed on July 28, 2003, have been carefully considered, but are not persuasive.

9. As explained in the rejections set forth above, the formation of silicon films using silicon fluoride and hydrogen as a material gas in a high-frequency plasma enhanced CVD process is known. Furthermore, US '794 and US '264 disclose the oxygen

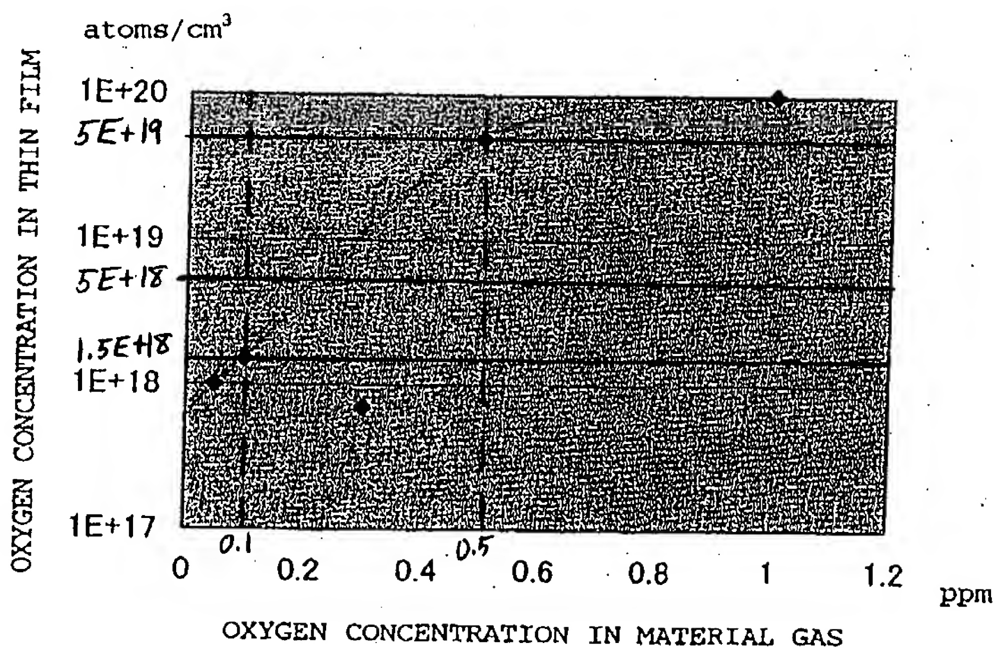
concentration of the final silicon film product within the claimed range. Both US '794 and US '264 disclose the formation of silicon layers using plasma CVD process (see col. 6, lines 16-20 and col. 6, lines 34-44, respectively). US '264 specifically discloses the use of silicon fluoride. US '794 discloses an example of forming a silicon film using silane and identifies the problem of high oxygen concentrations in silane material gases (col. 8, lines 23-36). Both US '794 and US '264 seek to reduce the amount of oxygen in the final silicon film using zeolites. This reduction results in a concentration of oxygen within the range recited in the instant claims. Since the final silicon film product has the same concentration as the silicon film in the instant claims, it is expected that the material gas would also have an oxygen concentration within the claimed range. This expectation is justified because the concentration of components in the material gas directly affects the concentration of components in the final film. In other words, in a plasma CVD process, the concentration of components in a film is directly dependent on the concentration of the material gas. A different oxygen concentration would have yielded a different concentration of oxygen in the deposited layer.

10. Applicant has argued, "[O]ne of the goals of the Yamazaki references, which is to remove all oxygen, is in direct contrast to the feature of Claim 1 discussed above, which is to include a specific oxygen content of 0.1 to 0.5 ppm in a material gas used to form a silicon-based film'" (see page 9 of Applicant's response).

11. Applicant's argument is not persuasive because the Yamazaki references do not teach silicon-based films having a zero oxygen concentration. Specifically, US '264 teaches an oxygen concentration "less than 5×10^{19} atoms/cm^3 and as low as 5×10^{18}

atoms/cm^3" (col. 6, lines 24-29). It is impossible for such a layer to be formed using a material gas having no oxygen, as suggested by Applicant. Similarly, US '794 teaches a film having an oxygen content of 5×10^{18} atoms/cm^3 or less (col. 8, lines 58-62).

12. Applicant has provided a graph (reprinted below) plotting the values of oxygen concentration in thin films and oxygen concentration in material gases used to form the thin films in response to the Examiner's position that the amount of oxygen contained within the material gas would necessarily require a concentration of oxygen lying within the range recited in the claims because the concentration of oxygen in the formed layer is within the same range as that claimed by Applicant. Applicant states, "As can be seen from the attached graph, the oxygen concentrations in the thin films do not vary directly with the oxygen concentrations in the material gases used to form the thin films" (see page 10 of Applicant's response).



13. This argument is not persuasive because for every value of oxygen concentration in the material gas, there is a definite corresponding value for the concentration of oxygen in the film. As can be seen in the markings added by the Examiner, because the concentration of oxygen in the film disclosed by Yamazaki in US '794, $5x10^{18}$ atoms/cm^3, lies between the data points shown for ~0.1 ppm and ~0.5 ppm, the oxygen concentration in the material gas used by Yamazaki '794 would necessarily lie within the claimed range of 0.1-0.5 ppm oxygen in the material gas, assuming that the function describing relationship between the gas concentration and film concentration is a continuous function. The assumption that the relationship is continuous is reasonable because every oxygen concentration in the material gas results in a definite concentration of oxygen in the film and the graph shows a relationship that an increase in material gas oxygen concetration generally yields an increase in oxygen in the film. (It is noted that all points except one follow this general pattern; due to the lack of experimental details used to generate the graph, the exceptional point is statistically considered an outlyer and is insufficient to sway the Examiner's position.) Since the oxygen concentration in the material gas would lie within the claimed range, the instant claims are not distinguished over the prior art.

14. Additionally, it is noted that Applicant's arguments contradict the data shown in the graph. Applicant argues that the concentrations are not directly related, but the point shown for 0.3 ppm in the material gas is not within the claimed concentration range within the film as recited in the claims. Applicant's argument therefore raises

questions as to either the uncertainty of the graph, especially with regard to the "outlyer", or the claimed ranges. Since the experimental procedure used to generate the graph is not disclosed, it is assumed that the graph is not accurate.

Conclusion

15. All claims are drawn to the same invention claimed in the application prior to the entry of the submission under 37 CFR 1.114 and could have been finally rejected on the grounds and art of record in the next Office action if they had been entered in the application prior to entry under 37 CFR 1.114. Accordingly, **THIS ACTION IS MADE FINAL** even though it is a first action after the filing of a request for continued examination and the submission under 37 CFR 1.114. See MPEP § 706.07(b). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian L. Mutschler whose telephone number is (571)

272-1341. The examiner can normally be reached on Monday-Friday from 7:30am to 4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

blm
February 3, 2004

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